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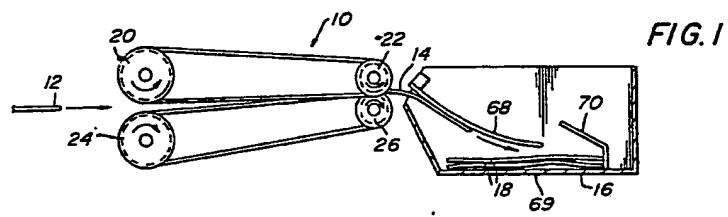
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54 Method and means for separating and stacking bills and the like.

57 A stack of bills or other sheets of paper, to be separated and stacked are fed to a conveyor system. The conveyor forms and creases the bills to form corrugations therein in such a way as to grossly increase the beam strength and thereby improve the handling and stacking of the bills.

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10 Method and Means for Separating and
 Stacking Bills and the Like

15 There have been numerous types of machines for separating
stacks of sheets of paper for the purpose of counting,
sorting or stacking. The sheets may include bank notes,
checks, currency, food stamps, coupons and the like.

20 One of the problems associated with the handling, conveying
and stacking sheets of paper material is that some of the
sheets have very low beam strength. This results in very
poor handling characteristics. In most cases, the hand-
ling characteristics degrade as the material is used, folded
or wrinkled. This is especially true of currency bills.
25 Also, when papers sheets are worn, they tend to be torn if
they are subjected to excessive stretching during the
handling operation.

30 It is an object of this invention to provide an improved
method and means for handling sheets of paper, such as
coupons, bills and notes.

35 It is a further object of this invention to provide novel
methods and means for treating sheets of paper to improve
the handling and stacking of the sheets, especially when
they are limp, torn, worn or folded.

1 It is still a further object of this invention to provide improved methods and means for handling and stacking sheets of paper without tearing the sheets.

5 It is still a further object of this invention to provide improved methods and means for stacking separated sheets of paper after they have been separated.

In accordance with the present invention, sheets of
10 material, such as currency notes, to be stacked are fed to a conveyor including two sets of conveyor belts. Each set of conveyor belts comprises a plurality of bands or narrow strips of belt which converge on the center line of the sheets as they are conveyed from a source to be
15 stacked in a bin. The bands in the respective sets of belts complement and overlap each other as the sheets are conveyed. The sets of conveyor belts perform the flat sheets into semi-corrugated shapes before delivering them to a set of creaser rolls and finally to the stacker
20 bin. The final creasing increases the beam strength of the sheets to improve their handling and stacking characteristics.

Other objects and advantages of the present invention
25 will be apparent and suggest themselves to those skilled in the art, from a reading of the following specification and claims, taken in conjunction with the accompanying drawings.

30 Fig. 1 is a side view, partly in cross-section, illustrating a conveyor system and stacker for sheets of paper or bills, in accordance with the present invention;

35 Fig. 2 is a top plan view of the conveyor system and stacker illustrated in Fig. 1;

Fig. 3 is a view taken along lines 3-3 of Fig. 2;

Fig. 4 is a view taken along lines 4-4 of Fig. 2;

Fig. 5 is a view taken along lines 5-5 of Fig. 2;

1 Fig. 6 is a view taken along lines 6-6 of Fig. 2; and
Fig. 7 is a view partly in cross-section, illustrating
another type of stacker bin which may be used with
the present invention.

5 Referring to Figs. 1 through 6 of the drawing, a conveyor
system 10 is disposed to receive a plurality of separated
bills 12 and 14, for example, from a suitable source or
feed station and convey them to a stacker bin 16 where
10 they are suitably stacked as illustrated by a stack of
bills 18. The conveyor system 10 includes a top belt
set including a plurality of band-like strips or belts
driven by a pair of rollers 20 and 22. In like manner,
a bottom belt set includes a plurality of band-like strips
15 or belts on rollers 24 and 26 which are also suitably
driven.

As illustrated in Fig. 2, the top belt set or pulley
system may include three belts or bands 28, 30, 32. The
20 bottom belt set includes two belts or bands 34 and 36.
The rollers 20, 22, 24 and 26 are moved in the direction
of the arrows so that bills fed to the conveyor system
are transported from a first station or source to a
second station, such as the bin 16 used for stacking the
25 bills 18.

The bills, such as the bill 12, are delivered sufficiently
close to the rollers 20 and 24 so as to be gripped by the
top and bottom sets of belts being driven by the rollers
30 20, 22, 24 and 26. After the bills are gripped by the
conveyor belts, they are conveyed, pre-shaped as they are
being conveyed, and finally creased, in a manner to be
described.

35 As illustrated in Fig. 2, the outer belts 28 and 32 of
the upper set of belts driven by rollers 20 and 22 converge
toward each other as they leave the roller 20 and move
toward the roller 22. The center band or belt 30 is

- 1 maintained in a relatively straight line as it is moved
from the roller 20 to the roller 22. The lower set of
bands or belts 34 and 36 also converge toward each other
as they leave the roller 24 and move toward the roller 26.
5 The belts 34 and 36 converge inwardly toward the center
or axis of the bill 14 in the same general direction as
the belts 28 and 32.

At the same time that the outer belts of the upper and
10 lower sets of belts converge towards each other or towards
the axis of the bill 14 in a generally horizontal plane,
the upper and lower sets of belts also converge towards
each other in a vertical plane as they move from rollers
20 and 24 to rollers 22 and 26. As the upper belts 28,
15 30 and 32 converge downwardly with respect to the lower
belts 34 and 36, both sets of belts become aligned in the
same horizontal plane when they reach the rollers 22 and
26. Thus the belts may be considered as converging
towards the axis of the bill 14 in two directions.

20

The roller 20 includes suitable grooves 29, 31 and 33
therein for receiving the bands or belts 28, 30, 32,
respectively. The roller 24 also includes similar types
of grooves (not illustrated) for receiving the belts 34
25 and 36. The roller 22 includes grooves 38, 40 and 42
for receiving belts 28, 30 and 32. The roller 26 also
includes similar grooves illustrated in Fig. 6.

30

The rollers 22 and 26 may be considered as creaser rollers
and may be of smaller diameters than the rollers 22 and
24, although this is not absolutely necessary. As
illustrated and mentioned in connection with Fig. 1, the
belts on the rollers 20 and 24 converge toward each other
in both the horizontal and vertical planes as they approach
35 the creaser rollers 22 and 26. At the final position on
the conveyor system 10, prior to the ejection of the bill
14, the bands 28, 30, 32, 34 and 36 of both pulley systems
are in alignment with each other in the same horizontal

1 plane between the creaser rollers 22 and 26, as illustrated
in Fig. 6.

Basically, sheets are fed between the upper and lower sets
5 of conveyor belts which converge on the center line of the
sheets on both axes. As the sheet, for example, sheet
14, is being transported it is deformed by the upper and
lower sets of conveyor belts. As illustrated in Figs. 3,
4 and 5, the upper belts 28, 30 and 32 push downwardly on
10 the sheet 14 whereas the lower belts 34 and 36 push up-
wardly on the sheet 14. Because of the staggered
relationship of the upper belts 28, 30 and 32 with respect
to the lower belts 34 and 36, parts of the sheet 14 are
pressed down whereas other parts in between are pressed up.
15 This causes the sheets to be performed into semi-corrugated
shapes as they are being transported.

As illustrated in Fig. 2, because of the performing of the
sheet 14 as it is being transported, the total width
20 between the other edges gradually become less as they
approach the creaser rollers 22 and 26.

Referring particularly to Fig. 6, the top creaser roller
22 includes grooves 38, 40 and 42 therein for receiving
25 the belts 28, 30 and 32, respectively. The bottom
creaser roller 26 includes grooves 44 and 46 for receiving
the belts 34 and 36 therein.

The upper creaser roller 22 includes outer or larger
30 diameter projecting areas 48, 50 and 52 which include the
grooves 38, 40 and 42 therein. Smaller diameter recessed
areas 54 and 56 are disposed between the adjacent project-
ing areas on either side. End portions 49 and 51 have
the same diameters as the recessed areas 54 and 56.
35

The bottom creaser roller 26 includes larger diameter
projecting areas 58 and 60 for receiving the grooves 44
and 46 therein. A smaller diameter recessed area 62 is

1 disposed between the projecting areas 58 and 60. Other
recessed portions 64 and 66 are of the same diameters as
the recessed area 62. End portions 61 and 63 are of the
same diameters as the projecting areas 58 and 60.

5

The creaser rollers 22 and 26 complement each other so
that the recesses 54 and 56 of the roller 22 are disposed
to receive the projecting portions 58 and 60 of the
roller 26. In like manner, projecting areas 48, 50 and
10 52 of the roller 22 extend into the recess areas 64, 62
and 66 of the roller 26. As illustrated, the outer ends
49 and 51 of the roller 22 are disposed relatively close
to the outer ends 61 and 63 of the roller 26.

15 The rollers 22 and 26 are disposed relatively close to each
other. However, they do have a small space there-
between for receiving therebetween the preformed bills 14
to be creased. One of the rollers is normally fixed while
the other is pivotally mounted. The pivotally mounted
20 roller may be spring biased inwardly which permits
multiple notes, thick notes or notes with staples, etc. to
be transported. Also, stops are normally provided to
limit movement of the pivotally mounted roller and prevent
it from physically contacting the fixed roller, thus avoid-
25 ing damage to the rollers.

When the bill 14 reaches the point of ejection from the
conveyor system 10 at the creaser rollers 22 and 26
illustrated in Fig. 6, it is somewhat corrugated in shape.
30 This gives added stiffness to the bill making it much
easier to handle and to stack.

After the bill has passed through the creaser rollers 22
and 26, it passes into the stacking bin 16. The ejected
35 bill is guided by a flexible guide means 68, which may be
thin spring-like metal or plastic, which directs the bill
downwardly toward the bottom wall 69 of the bin 16. The
guide means 68 moves upwardly as the bills are piled

- 1 progressively higher. A back stop element 70 is included
in the bin to limit the forward movement of the bill to
provide a neat stacking of the bills.
- 5 It is noted that the bills are preformed or corrugated
gradually prior to the final creasing operation. This
results in the outer edges of the bills moving closer to
the axis. This action in effect makes more paper avail-
able for creasing within a small width. If the bills
10 were subjected to the final creasing operation without
this preforming, they would tend to tear as a result of
stretching because no excess paper area to permit corru-
gation would be available.
- 15 Referring to Fig. 7, another embodiment of the bill
stacker bin is illustrated. The basic conveyor system
is the same as that previously described. However, the
bin arrangement permits the bills to be stacked on edge.
The ejected bills are guided by a guide member 72 toward
20 the wall 73 of the bin 74. A flexible hold back means 76
is employed to hold the bills down against the wall 73 of
the bin. The hold back feature of the hold back means
76 assures high reliability when the bills are moved at
relatively high feed rates. The flexible guide 72 steers
25 and holds the bills behind the hold back 76, slows the
bills down and snaps them out of the way of succeeding
notes or sheets. The flexible guide 72 also prevents any
of the bills or notes from falling back into the path of
the oncoming notes. The hold back feature serves to hold
30 the notes against the wall 73 of the bin after they clear
the guide and promote easy stacking, especially when the
bills are stacked on edge.
- 35 While the conveyor system has been described as including
three top conveyor belts and two bottom conveyor belts,
it is apparent that the number of belts may differ depend-
ing upon the particular size and the number of corrugations
desired in the bills. It is also apparent that either

- 1 one of the top or bottom set of rollers may be driven with
the other roller being a follower roller.

- The various motor means for moving the rollers are not
5 illustrated since such details are well known to those
skilled in the art. Many mechanical features well known
to those skilled in the art are also not illustrated.
For purposes of clarification, only the features directly
related to the invention are shown in detail, with the
10 many other features necessary to implement a system being
well known to those skilled in the art.

- References to such terms as vertical and horizontal have
been made with respect to the way the elements were illus-
15 trated on the drawing. These references were made for
purposes of explanation. It is apparent that the positions
of the elements may be different than those illustrated.

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1 Claims:

1. Means for conveying sheets of material from a feed station to a utilization station comprising:
 - 5 (a) a pair of movable conveyor means for receiving said sheets and transporting them from said feed station to said utilization station, and
 - (b) said conveyor means being disposed to deform the sheets into semi-corrugated shapes as they are
10 transported from said feed station to said utilization station.
2. Means for conveying as set forth in claim 1, wherein creaser means are provided to crease said bills prior to
15 delivery to said utilization station.
3. Means for conveying sheets of material as set forth in claim 2, wherein each of said conveyor means includes a first conveyor belt driven by a first pair of rollers
20 and a second conveyor belt driven by a second pair of rollers.
4. Means for conveying sheets of material as set forth in claim 3, wherein said creaser means includes a pair of
25 creaser rollers comprising one roller from each of said first and second pairs of rollers, said creaser rollers being in close proximity with each other to receive said sheets therebetween to form them into corrugated shapes prior to delivering them to said utilization station
30 including a bin for stacking.
5. Means for conveying sheets of material as set forth in claim 4, wherein each of said first and second conveyor belts comprises a plurality of strips, with the strips of
35 each of the belts being disposed in a staggered relationship with respect to the strips of the other belt, said strips of both conveyor belts converging towards each other as they move towards said pair of creaser rollers.

- 1 6. Means for conveying sheets as set forth in claim 5,
wherein said first and second pairs of rollers include
grooves for receiving said strips of said conveyor belts
therein.
- 5 7. Means for conveying sheets of material as set forth
in claim 6, wherein the strips of both conveyor belts are
in substantial alignment with each other when said sheets
are received by said creaser rollers.
- 10 8. Means for conveying sheets of material as set forth
in claim 7, wherein the strips of each of said belts con-
verges inwardly as they move from said feed station towards
said pair of creaser rollers.
- 15 9. Means for conveying sheets of material as set forth
in claim 8, wherein the strips of said conveyor belts
converge so as to collapse the cross-section of sheets
prior to delivering them through said pair of creaser
20 rollers.
- 25 10. Means for conveying sheets of material as set forth
in claim 9, wherein said bin for stacking said sheets
received from said pair of creasers include flexible
guide member to steer said sheets out of the way of
succeeding sheets towards a wall of said bin and a flex-
ible hold member to hold the stacked sheets of bills
against the wall of said bin.
- 30 11. Means for conveying sheets of material as set forth
in claim 10, wherein each of said creaser rollers include
projecting portions and recessed areas disposed to com-
plement recess areas and projections, respectively, in
the other creaser roller, with the entire width of said
35 sheets being finally creased in accordance with the shapes
of said creaser rollers.

FIG. 1

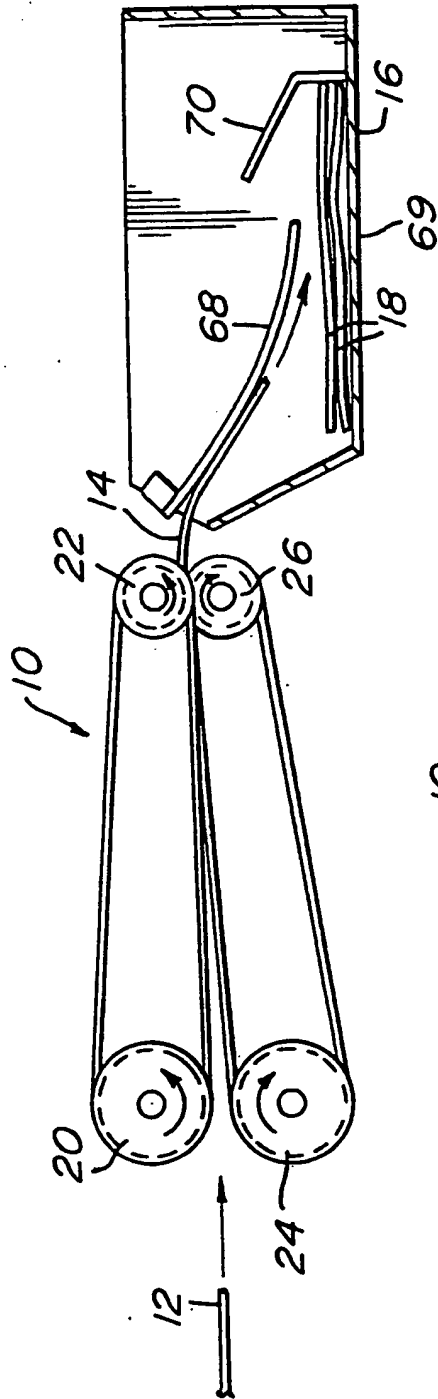


FIG. 2

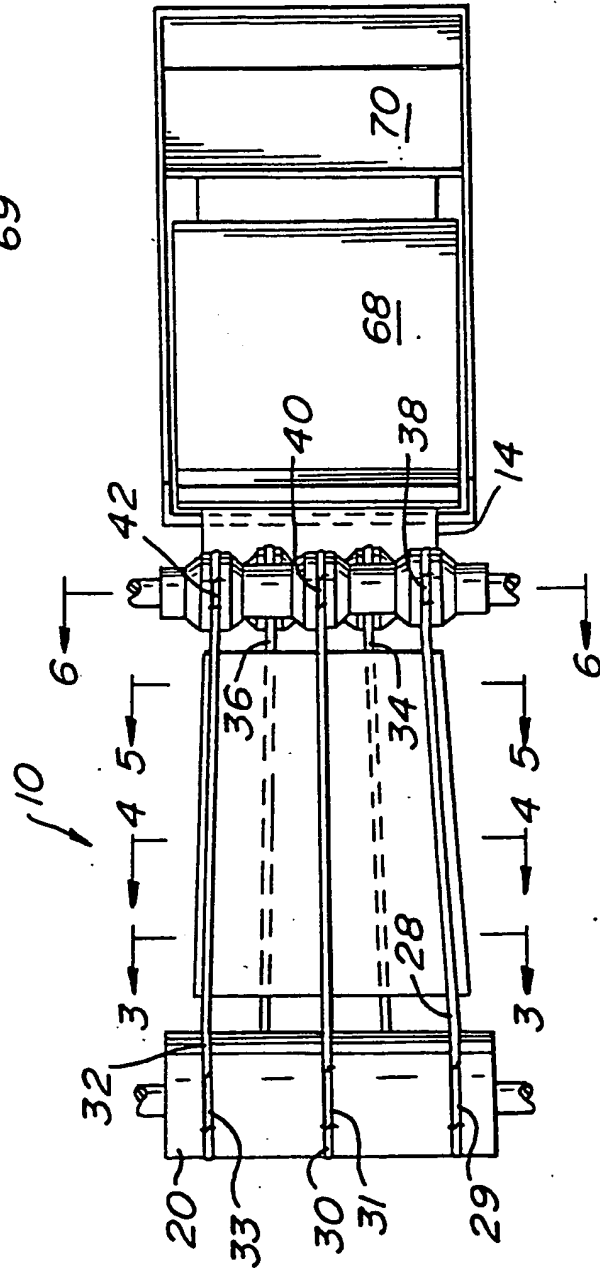


FIG.6

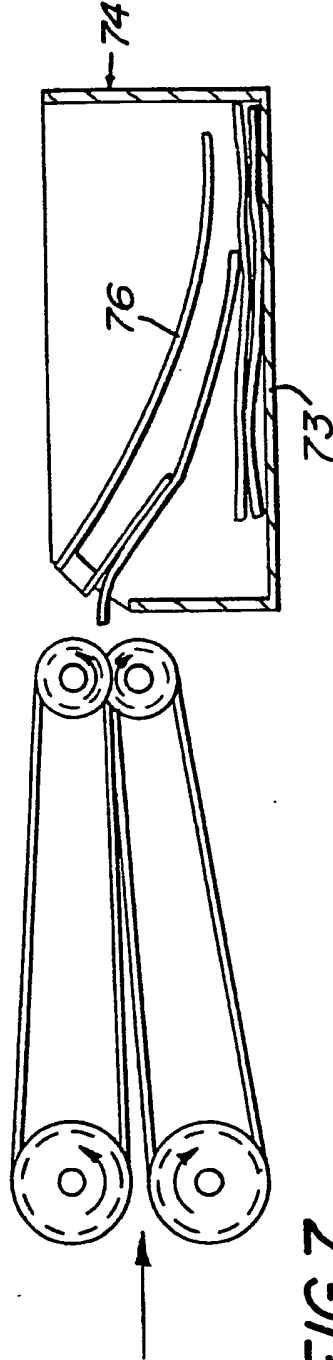
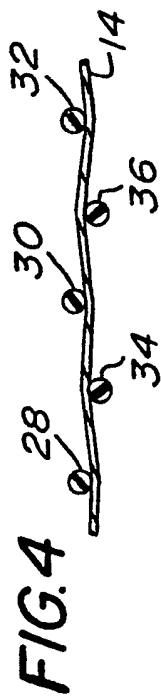
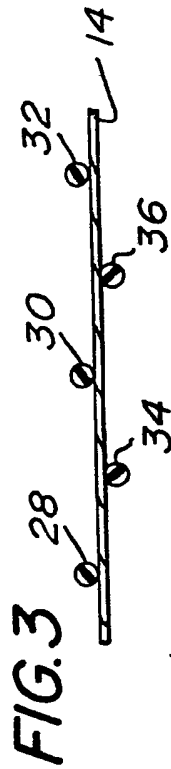
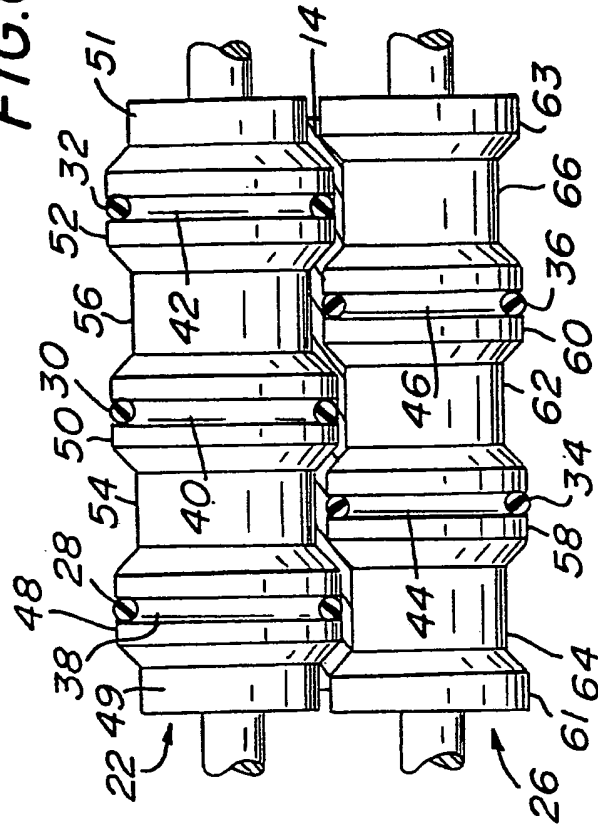


FIG.7